-- An electronic device and a method for producing the electronic device which has at least one microscopically small contact area for an electronic circuit having interconnects that are on a surface of a substrate. A three-dimensionally extending microscopically small contact element is integrally one-piece connected to the contact area. --

a13

Page 51, line 16, delete the paragraph reading, "[Figure 1]".

In the Claims:

Cancel claims 1-51 and enter the following new claims.

a14 Sub B1

-- 52. An electronic device, comprising:

a substrate having a surface; and

an electronic circuit having interconnects formed on said surface of said substrate;

said electronic circuit including at least one microscopically small contact area;

said contact area including a microscopically small contact element that is integrally connected to said contact area in

a14 contd Sub B1

one piece, said contact area extending from said contact area in three dimensions.

53. The electronic device according to claim 52, in combination with an intermediate carrier having a contact connection area and flat conductors, wherein:

said contact area of the electronic device is configured opposite the contact connection area of the intermediate carrier.

54. The electronic device according to claim 52, wherein:

said substrate is selected from the group consisting of a semiconductor chip and a semiconductor wafer; and

said electronic circuit includes at least one integrated circuit near said surface of said substrate.

55. The electronic device according to claim 52, wherein

said interconnects have ends; and

said at least one contact area includes a plurality of contact areas, each one of said plurality of said contact

A14 SuB7 Cont'd B1

areas configured on a respective one of said ends of said interconnects.

56. The electronic device according to claim 52, wherein said contact element is elastically deformable.

57. The electronic device according to claim 52, wherein said contact element is preformed at a solid angle that deviates from a direction orthogonal to said surface.

58. The electronic device according to claim 52, wherein said contact element is pre-bent at a solid angle that deviates from a direction orthogonal to said surface.

59. The electronic device according to claim 52, wherein said surface of said substrate has a largest bulging and said contact element has a length that is at least 5% greater than said largest bulging of said surface of said substrate.

60. The electronic device according to claim 52, in combination with an intermediate carrier having a contact connection area and flat conductors, wherein:

a14 SuB B1 cont'd

said contact area of the electronic device is configured opposite the contact connection area of the intermediate carrier; and

said contact element has a length that is at least 5% greater than a largest distance between said contact area and the contact connection area of the intermediate carrier.

61. The electronic device according to claim 52, wherein:

said substrate has a centrally located neutral point; and

said contact element has a length that is at least 5% greater than a largest length difference with regard to said centrally located neutral point of the substrate in an event of maximum thermal cycling.

62. The electronic device according to claim 52, in combination with an intermediate carrier having a contact connection area and flat conductors, wherein:

said contact area of the electronic device is configured opposite the contact connection area of the intermediate carrier;

a14 Sub B' contd

said substrate of the electronic device has a centrally located neutral point; and

said contact element has a length that is at least 5% greater than a largest length difference between said substrate and the intermediate carrier relative to said centrally located neutral point of said substrate in an event of maximum thermal cycling.

63. The electronic device according to claim 52, wherein said contact area and said contact element are produced from an identical metal alloy.

64. The electronic device according to claim 52, wherein said contact area is produced from an aluminum alloy and said contact element is produced from a gold alloy.

65. The electronic device according to claim 52, wherein said contact area is produced from an aluminum alloy and said contact element is produced from a copper alloy.

66. The electronic device according to claim 52, wherein said contact element is designed as a contact pin.

G14 Sub P1 cont'd

67. The electronic device according to claim 52, in combination with an intermediate carrier having a contact connection area and flat conductors, wherein:

said contact area of the electronic device is configured opposite the contact connection area of the intermediate carrier;

said substrate of the electronic device has a centrally located neutral point;

said contact element has a length that is at least 5% greater than a largest length difference between said substrate and the intermediate carrier relative to said centrally located neutral point of said substrate in an event of maximum thermal cycling;

said contact area has a shortest linear dimension; and

said contact element is designed as a contact pin that has a diameter which is not greater than half of said shortest linear dimension of said contact area.

a14 Contd SUB B1

68. The electronic device according to claim 52, in combination with an intermediate carrier having a contact connection area and flat conductors, wherein:

said contact area of the electronic device is configured opposite the contact connection area of the intermediate carrier;

said substrate of the electronic device has a centrally located neutral point;

said contact element has a length that is at least 5% greater than a largest length difference between said substrate and the intermediate carrier relative to said centrally located neutral point of said substrate in an event of maximum thermal cycling;

said contact element is designed as a contact pin having an end with a contact head; and

said end of said contact pin is remote from said contact area.

69. The electronic device according to claim 52, comprising:

AH Sub B' 7 contd

a coating selected from the group consisting of a nickel coating and a gold coating;

said contact element is designed as a contact pin having an end with a contact head that is coated with said coating; and

said end of said contact pin is remote from said contact area.

70. The electronic device according to claim 52, comprising:

a coating made of a solderable metal alloy;

said contact element is designed as a contact pin having an end with a contact head that is coated with said coating; and

said end of said contact pin is remote from said contact area.

71. The electronic device according to claim 52, wherein

said contact element is designed as a contact pin having an end with a contact head made from solder; and

a14 Sub B7 Contd

said end of said contact pin is remote from said contact area.

72. The electronic device according to claim 52, wherein said contact element is designed as a contact spring.

73. The electronic device according to claim 72, wherein:

said contact spring is a contact leaf spring having an end connected to said contact area and a free contact spring end extending three-dimensionally.

74. The electronic device according to claim 73, wherein said contact area has a width and said leaf spring has a width that corresponds to said width of said contact area.

75. The electronic device according to claim 73, wherein said leaf spring has a square cross section, and said free contact spring end of said leaf spring is tapered.

76. The electronic device according to claim 72, wherein said contact spring extends three-dimensionally at a solid angle α which is smaller than an angle of an orthogonal from said contact area.

G14 cont'd Sub B1 7

77. The electronic device according to claim 72, comprising:

a coating selected from the group consisting of a gold coating and a nickel coating;

said contact spring has a free contact spring end that is provided with said coating.

78. A method for producing an electronic device having microscopically small contact areas and interconnects that are formed on a surface of a substrate and having three-dimensionally extending microscopically small contact elements that are respectively integrally connected to the contact areas in one piece, the method which comprises:

patterning a conductive layer on a surface of a substrate to form interconnects and microscopically small contact areas;

applying a passivation layer to the patterned conductive layer;

opening contact windows in the passivation layer in order to uncover the contact areas;

9 14 Cont'd Sub B1 7

applying a closed conductive layer in order to connect the contact areas;

applying a masking layer to the closed conductive layer;

patterning the masking layer with through openings that extend to the closed conductive layer near the contact areas;

filling the through openings with conductive material to form three-dimensionally extending microscopically small contact elements that are respectively integrally connected to the contact areas in one piece;

removing the masking layer; and

removing the closed conductive layer.

79. The method according to claim 78, which comprises using photolithography methods to perform the steps of patterning the conductive layer and opening the contact windows in the passivation layer.

80. The method according to claim 78, which comprises performing the step of applying the closed conductive layer using a technology selected from the group consisting of

a14 SUB B1 Contd

vapor-deposition technology, sputtering technology and deposition technology.

81. The method according to claim 78, which comprises using a copper alloy layer as the closed conductive layer.

82. The method according to claim 78, which comprises performing the step of applying the masking layer to the closed conductive layer using a process selected from the group consisting of spinning on, spraying on, and immersion.

83. The method according to claim 78, which comprises using a photosensitive dielectric as the masking layer.

84. The method according to claim 83, which comprises exposing the masking layer made of the photosensitive dielectric at a solid angle with respect to the contact areas in order to produce three-dimensionally angled contact elements.

85. The method according to claim 78, which comprises using photolithography to perform the step patterning of the masking layer.

a14 Sub B1 Cont'd

86. The method according to claim 78, which comprises using a resin layer as the masking layer that is applied to the closed conductive layer.

87. The method according to claim 78, which comprises using a process selected from the group consisting of laser removal technology, ion beam sputtering, and plasma etching to perform the step of patterning the masking layer with through openings.

88. The method according to claim 78, which comprises using electro-deposition to perform the step of filling the through openings with conductive material.

89. The method according to claim 78, which comprises using electroless deposition technology to perform the step of filling the through openings with conductive material.

90. The method according to claim 78, which comprises using etching technology to perform the step of removing the closed conductive layer.

91. The method according to claim 78, which comprises forming contact heads using a process selected from the group consisting of electrodeposition and an electroless process.

Sub B1 7

914 cont'd

92. The method according to claim 78, which comprises potting spaces between the contact elements.

93. The method according to claim 92, which comprises performing the step of potting the spaces using a technology selected from the group consisting of spraying technology and injection-molding technology.

94. The method according to claim 78, which comprises:

forming contact heads using a process selected from the group consisting of electrodeposition and an electroless process;

potting interspaces between the contact elements; and

uncovering the contact heads after performing the step of potting of the interspaces between the contact elements.

95. The method according to claim 94, which comprises using laser removal technology to perform the step of uncovering the contact heads.

Sub B1 7

914 cont'd

96. The method according to claim 78, which comprises coating the contact heads with a metal selected from the group consisting of nickel and gold.

97. A method for producing an electronic device having at least one microscopically small contact area, which comprises:

providing a substrate having a surface and a plurality of contact areas that are integrally connected to a plurality of three-dimensional microscopically small contact elements, the plurality of the contact areas being for at least one electronic circuit having interconnects located on the surface of the substrate;

patterning a metal sheet to produce a plurality of uncovered contact spring contours having breaking locations that are connected to the metal sheet and having uncovered ends which correspond in size, configuration and position to the plurality of the contact areas of the substrate;

aligning and pressing the patterned metal sheet onto the substrate so that the uncovered ends of the plurality of the contact spring contours are pressed onto the plurality of the contact areas;

Sub B1 7

Q14 Contd

heating the metal sheet and the substrate to bond the uncovered ends of the plurality of the contact spring contours to the plurality of the contact areas; and

cooling and stripping-off of the metal sheet, leaving behind three-dimensionally extending, bonded or soldered contact springs on each of the plurality of the contact areas.

98. The method according to claim 97, which comprises, before pressing the metal sheet onto the substrate, coating the uncovered ends of the plurality of the contact spring contours with a layer that is selected from the group consisting of a nickel layer and a gold layer.

99. The method according to claim 97, which comprises coating the plurality of the contact spring contours with a solderable metal alloy near the breaking locations.

100. The method according to claim 97, which comprises:

providing a spring-elastic material having a thickness between 30 and 100 μm with a solderable tin layer; and then

providing the material as the metal sheet that is patterned.

Sub B1 914 end

101. The method according to claim 97, which comprises, before pressing the metal sheet onto the substrate, soft annealing regions of the plurality the contact spring contours.

102. The method according to claim 101, wherein the regions are central regions of the plurality the contact spring contours.

103. The method according to claim 97, which comprises:

using a soft metal sheet as the metal sheet that is patterned; and

after the metal sheet has been stripped off, heat-treating the three-dimensionally extending contact springs to obtain a desired spring property.

104. The method according to claim 97, which comprises providing the metal sheet as a copper alloy metal sheet having patterns. --